# ENERGY FOCUS

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## Catalyst with AuCu core–Pt shell increases stability of fuel cell

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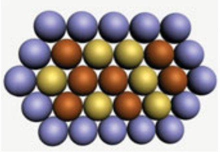
To reduce costs and increase the stability of the catalyst material in fuel cells, researchers at the Institute of Bioengineering and Nanotechnology at A*STAR in Singapore have replaced the central part of the commercial platinum catalyst with a gold and copper alloy, leaving just the outer layer in platinum. The team of researchers, led by Jackie Y. Ying, reported that their nanocomposite material can pass (with minimal overpotential) at least 0.57 A per mg of Pt from the electrocatalytic reaction of oxygen with hydrogen in the fuel cell, compared to 0.10 A per mg of Pt for commercial platinum catalysts. The gold-copper alloy core of the nanocrystalline material has slightly smaller lattice spacing than the platinum coating on the nanocrystal's surface. This creates a compressive strain on the surface platinum atoms, making the platinum more active in the rate-limiting step of oxygen reduction for the fuel cell. Replacing the core of the nanoparticle with a gold-copper alloy can also reduce the cost (Au and Pt prices are similar).



This nanocomposite material, composed of gold-copper alloy atoms in the core and platinum atoms at the outer layer, provides longer stability and reduced costs over commercial platinum catalysts for fuel cells. Image courtesy of Agency for Science, Technology and Research (A*STAR), Singapore.

## Spin waves revealed in 2D high-temperature superconductors

*Nature Mater.* DOI: 10.1038/nmat3409

In order to take advantage of high-temperature superconductors that can conduct electricity without any losses, thereby improving energy efficiency and, thus, saving energy, researchers are looking for superconductor materials that work at room temperature. An international team of researchers from Brookhaven National Laboratory, Paul Scherrer Institute, University College London, the Leibniz Institute for Solid State Research in Dresden, and the Swiss Federal Institute for Technology in Lausanne is now closer to revealing the origin of high-temperature superconductivity. Using a custom-built molecular beam epitaxy machine, Brookhaven Lab's Ivan Bozovic grew samples of nanoscale superconducting materials that consisted of two-dimensional layers of lanthanum copper oxide ($La_2CuO_4$) stacked and separated by insulators to prevent interference between layers. The x-rays in a resonant inelastic x-ray scattering experiment only interacted with the copper atoms in the sample, making the insulator scaffolding effectively invisible and isolating the superconductor layers to precisely probe for spin wave behavior. The researchers reported that the difference in energies demonstrated that the energy transferred to these magnetic spins created a spin wave behavior.

## Thermoelectric material increases capture of waste heat

*Nature* DOI: 10.1038/nature11439

By controlling the mesoscale architecture of PbTe nanostructured thermoelectric materials, researchers at Northwestern University, led by Mercouri G. Kanatzidis, have fabricated the most efficient thermoelectric material to date, with a figure of merit (ZT) >2. This material, with a ZT of approximately 2.2 at 915 K, could lead to a viable method of turning some of the high-temperature waste heat, which is responsible for the loss of almost two-thirds of the energy used, into electricity. While nanostructured thermoelectric materials have been effective in scattering heat-carrying phonons with short and medium mean free paths, this new material, which includes meso- and nanostructural features, can also scatter phonons with long mean free paths. This hierarchical architecture greatly reduces the overall lattice thermal conductivity, making it possible to trap more heat that can be converted to electricity, thus increasing ZT.

## Lab simulates energy usage in home

www.nist.gov

The US National Institute of Standards and Technology (NIST) unveiled a laboratory designed to demonstrate that a two-story, four-bedroom, three-bath suburban home for a family of four can generate as much energy as it uses in a year. With this Net-Zero Energy Residential Test Facility, NIST researchers will use computer software and mechanical controls to simulate the activities of a family living in an energy-efficient home. Lights will turn on and off at specified times, hot water and appliances will run, and small devices will emit heat and humidity just as people would. A solar photovoltaic system will generate electricity to power lights and appliances when weather permits, and excess energy will be sent back to the local utility grid by means of a smart electric meter. The house will draw energy from the grid on days it cannot generate enough on its own, but over the course of a year, it will produce enough to make up for that purchased energy, for a net-zero energy usage. □

With this laboratory, researchers will simulate a family of four living in an energy-efficient home and monitor how the house performs. Credit: NIST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